SERVIR
Connecting Space to Village

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About SERVIR

A NASA-USAID <u>partnership</u> to improve environmental management and resilience to climate change by strengthening the capacity of governments and other key stakeholders to integrate earth observation information and geospatial technologies into development decision-making

SERVIR Network
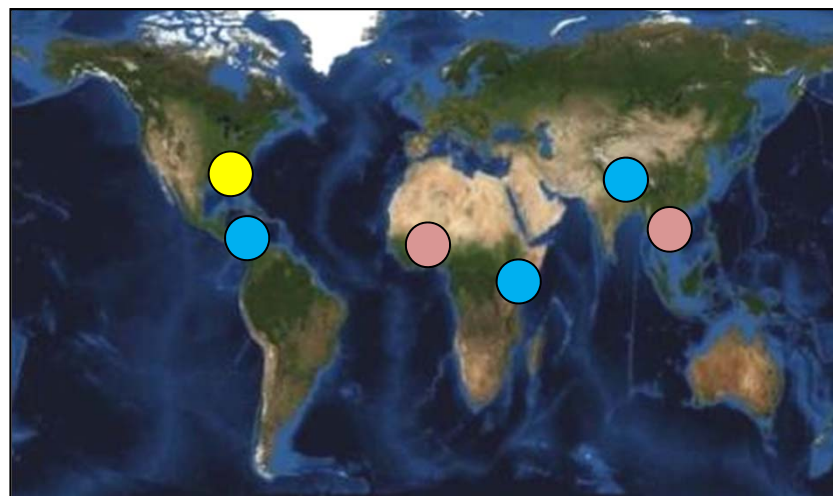
SERVIR Network

- 🔵 SERVIR Hub
- 🟡 Program Office (NASA/MSFC)
- 🔴 Potential Future Hubs

RCMRD – Host of SERVIR-East Africa

**ICIMOD** – Host of SERVIR-Himalaya

CATHALAC – Host of SERVIR-Mesoamerica

What We Do

- Identify needs in SERVIR regions
- Link science products from US institutions to meet those needs through improved access to data, models, online maps, and visualizations
- Build capacity of regional institutions, stakeholders, and young professionals
- Strengthen partnerships and foster collaboration across SERVIR network
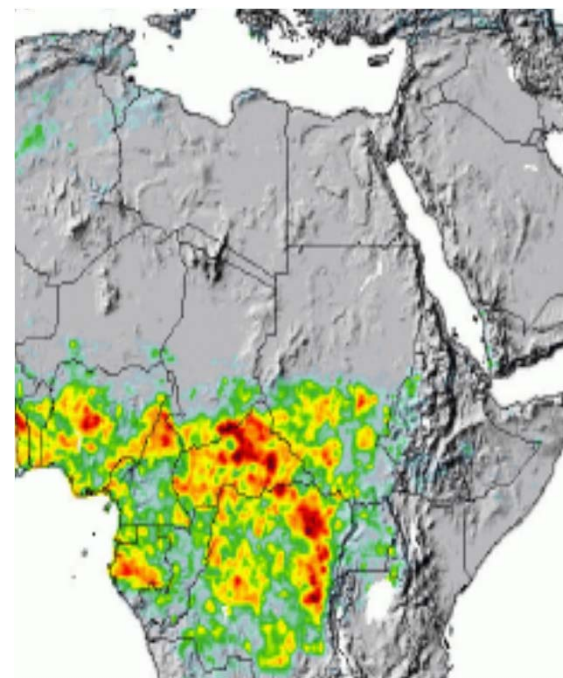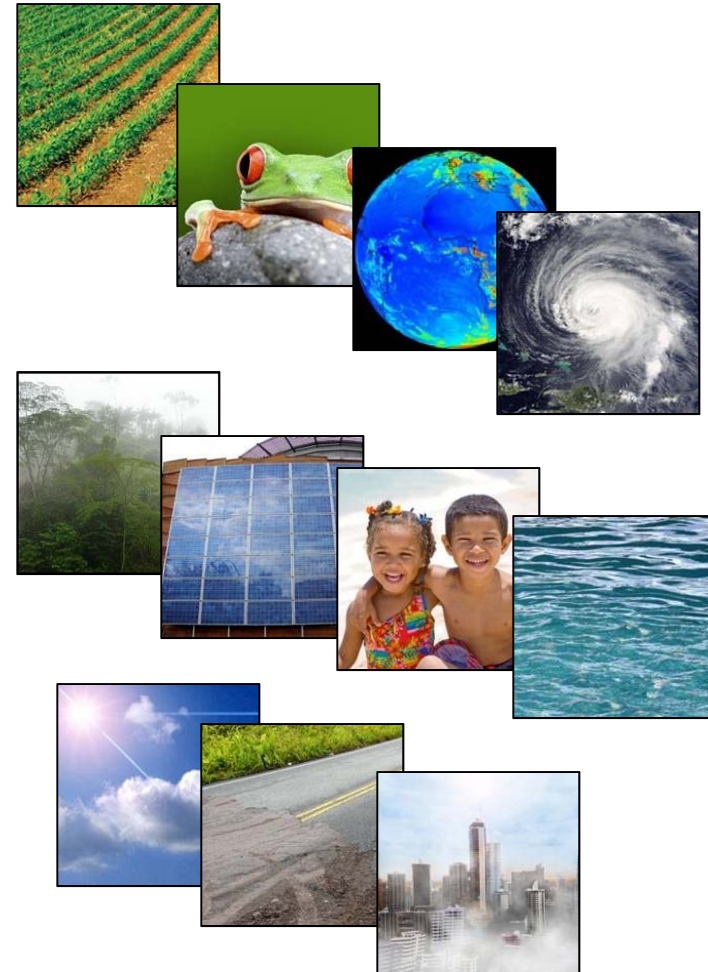
Science

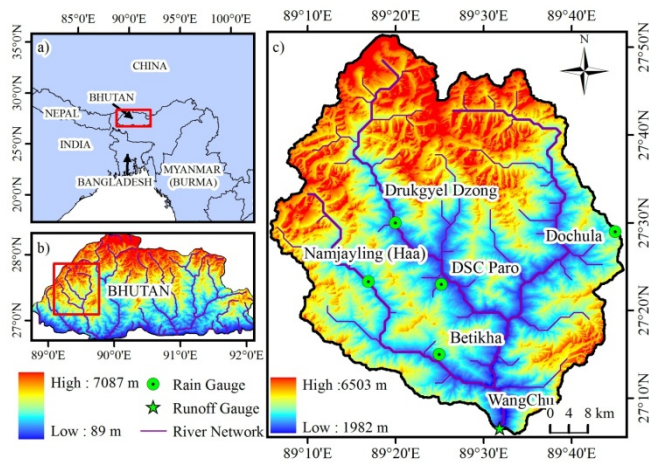End User Needs

Courtesy: alifayre

SERVIR Thematic Areas

- Agriculture
- Biodiversity
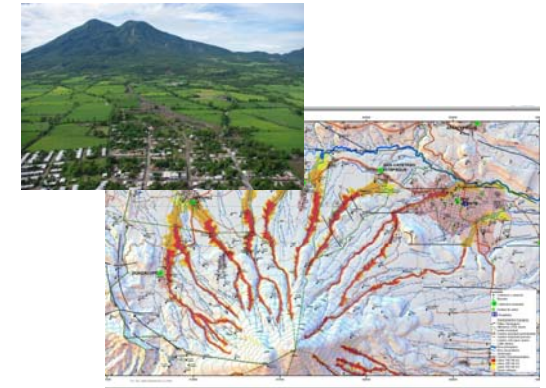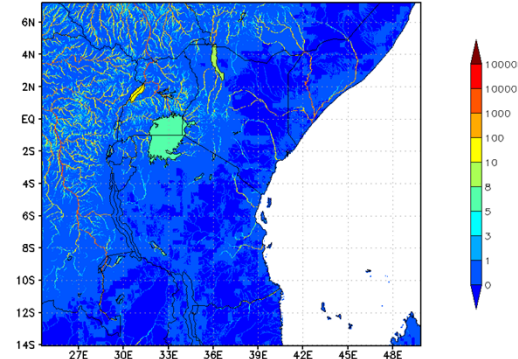- Climate
- Disasters
- Ecosystems
- Energy
- Health
- **Water**
- Weather

SERVIR Science Applications for Decision Making

Bhutan Water Resource Assessment

Real Time Streamflow in East Africa

Landslide Prediction System in Mesoamerica

Frost Mapping in Africa

Near Real-time Forest Fire Monitoring in Nepal
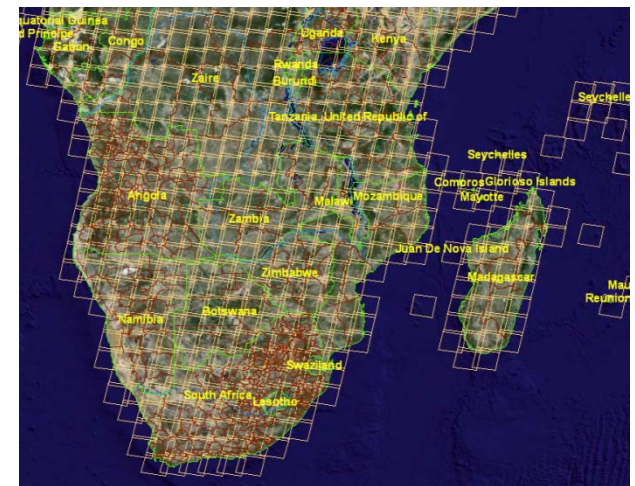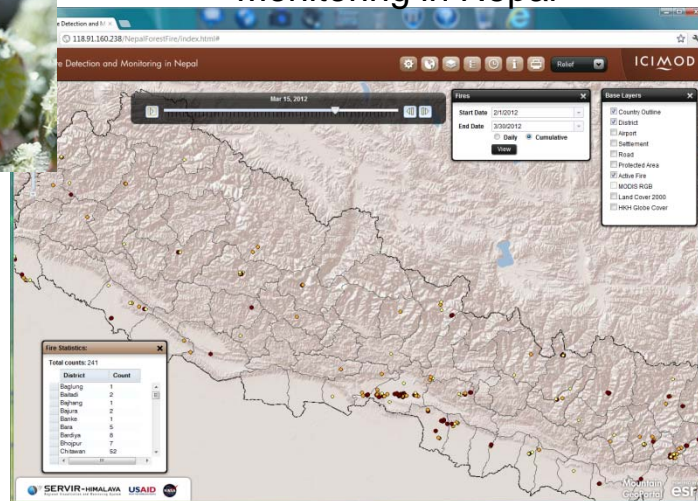
Greenhouse Gas Emissions Inventory in Africa

- Needs assessment in East Africa identified characterization and forecasting of droughts and floods as two most pressing needs.

- Ministry of Water in Kenya, Rwanda, Uganda, and Tanzania do not have real time assessments of hydrologic conditions
  - Very few real time stream gages, even fewer in working condition.
  - District managers need real time information to inform the local authorities of floods, ideally forecasts with several hours of lead time.

- Spatially distributed hydrologic model CREST, developed under a ASP ROSES project at GSFC.
- Spatial resolution 1km, run every 3 hours using near real time data in the Amazon cloud
- Uses near real-time satellite-derived rainfall estimates and rainfall forecasts from Kenya Meteorological Department (KMD) to produce streamflow
- Streamflow estimates enable Kenya Department of Water Resources to issue early flood warning, especially in the flood prone watersheds in western Kenya.
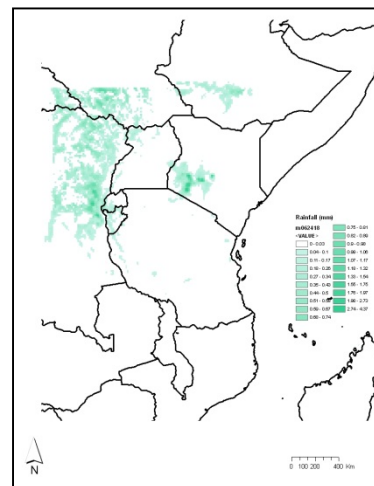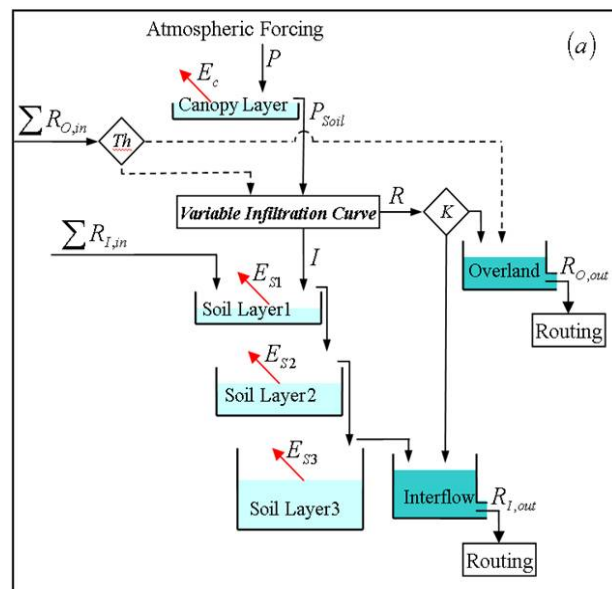
KMD QPF
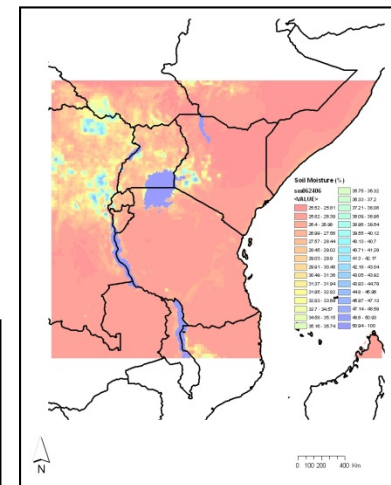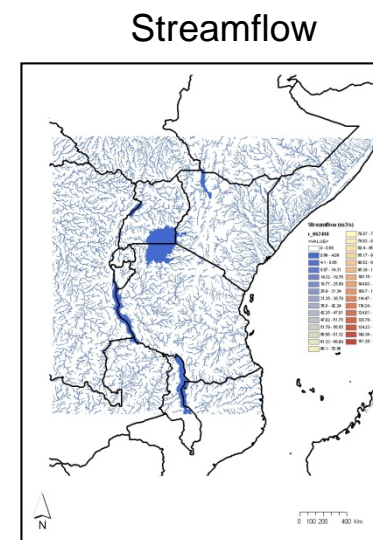
Streamflow

Soil Moisture

Historical Data Perspective

- SERVIR has used 10-year historical satellite rainfall data to drive the CREST model, which has resulted in historical daily streamflow at 1 km resolution.

- Those historical and near real time data are shared with Kenya Department of Water Resources (KDWR) for ~850 stream gage locations of their choice. SERVIR Africa makes the data available on our web portal and through automated emails to KDWR-identified field hydrologists.

- We have used the historical data to assess 5th, 20th, 80th and 95th percentiles for each 1 km pixel to put the real time streamflow in context.

Latest 24h/3h Stream Flow (m^3/s) 2013-09-19 15h
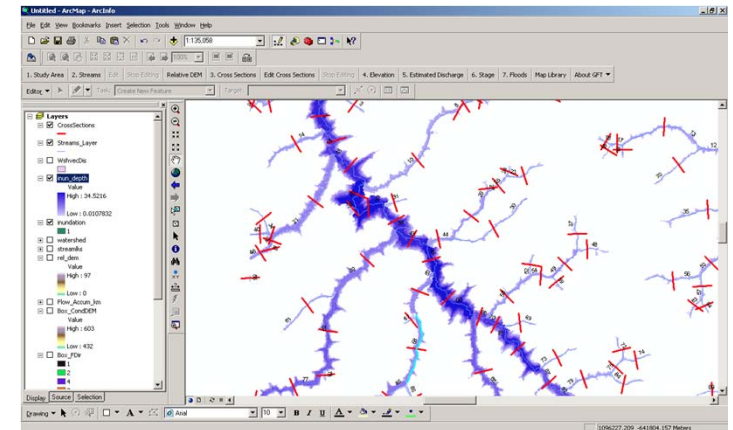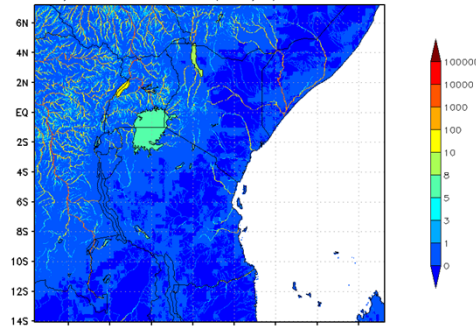
Streamflow at Nzoia

Comments from CREST End User

"The biggest problem we have is lack of data. When someone, like SERVIR Africa comes along to help us out it is very good because we have been missing floods."

-Simintei Kooke
Deputy Director of Water Resources,
Kenya Ministry of Water and Irrigation

Hydrologic Model CREST Developed for Single Watershed in Kenya
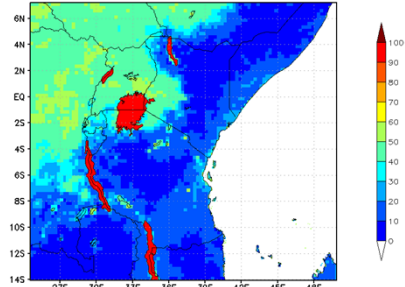
Real Time, Historic and Seasonal Streamflow

Soil Moisture
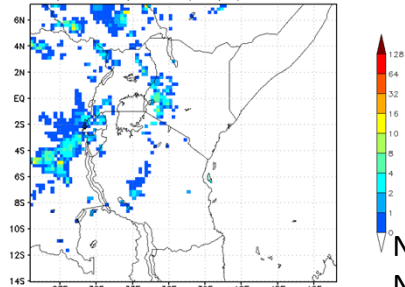
Near Real Time NASA TRMM Satellite Rainfall Data

Working on seasonal hydrologic forecasts at the request of Kenyan and Rwandan Ministries of Water Resources
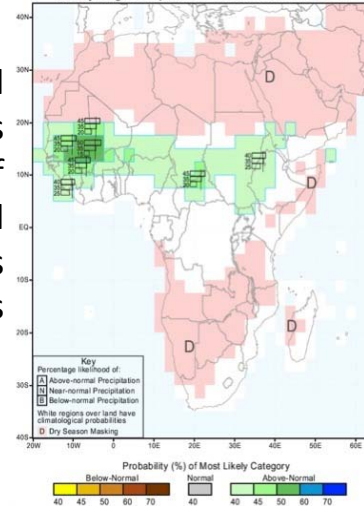
Working in collaboration with FEWS NET, and at the request of KDWR, RCMRD developed stand alone Flood mapping tool. It translates the streamflow into a better visualization and decision making tool.

Training and Capacity Building

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SERVIR has adapted CREST model products to fit the mobile needs.

CREST app runs on iOS and Android devices.
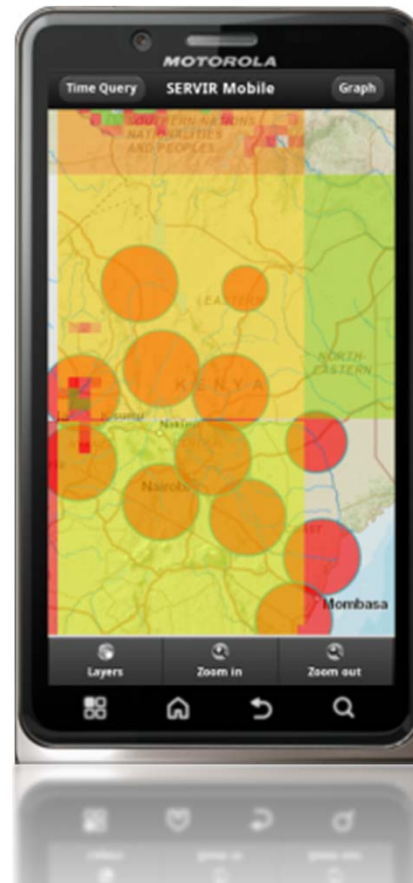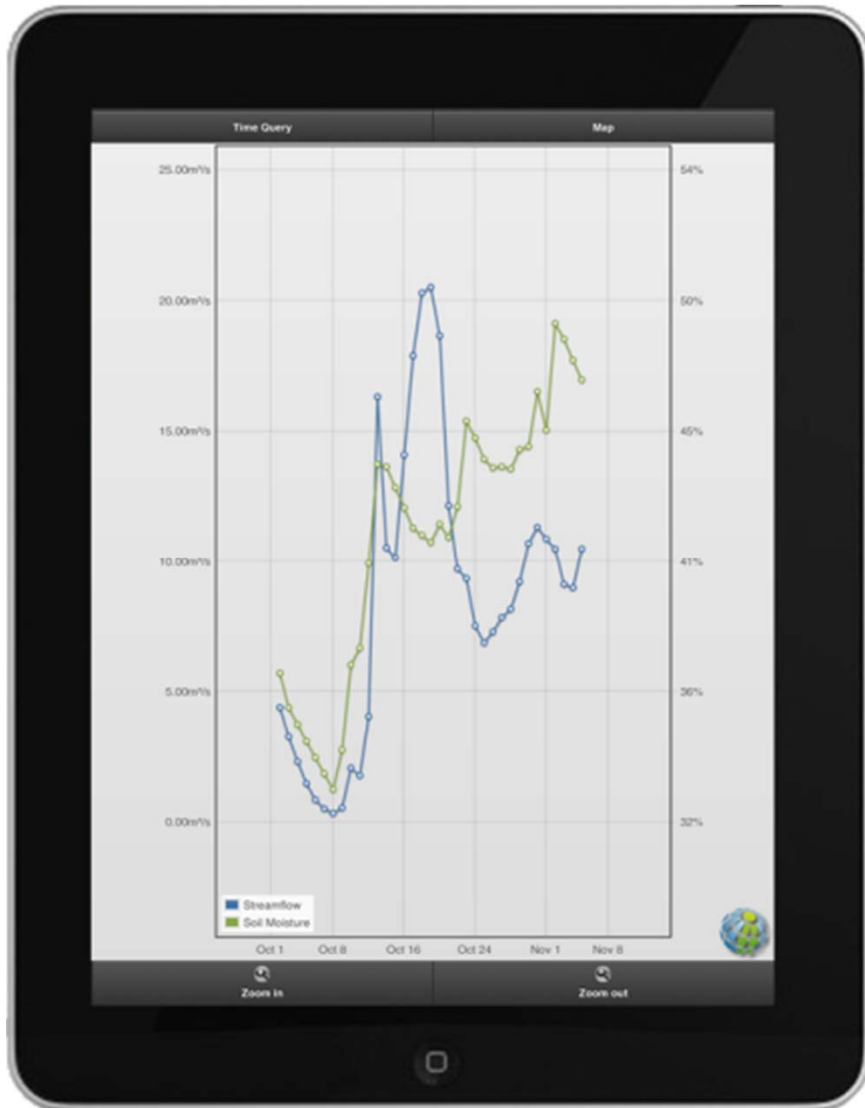
Frost Monitoring and Early Detection

Estimated Frost Occurrences on 2013-06-14
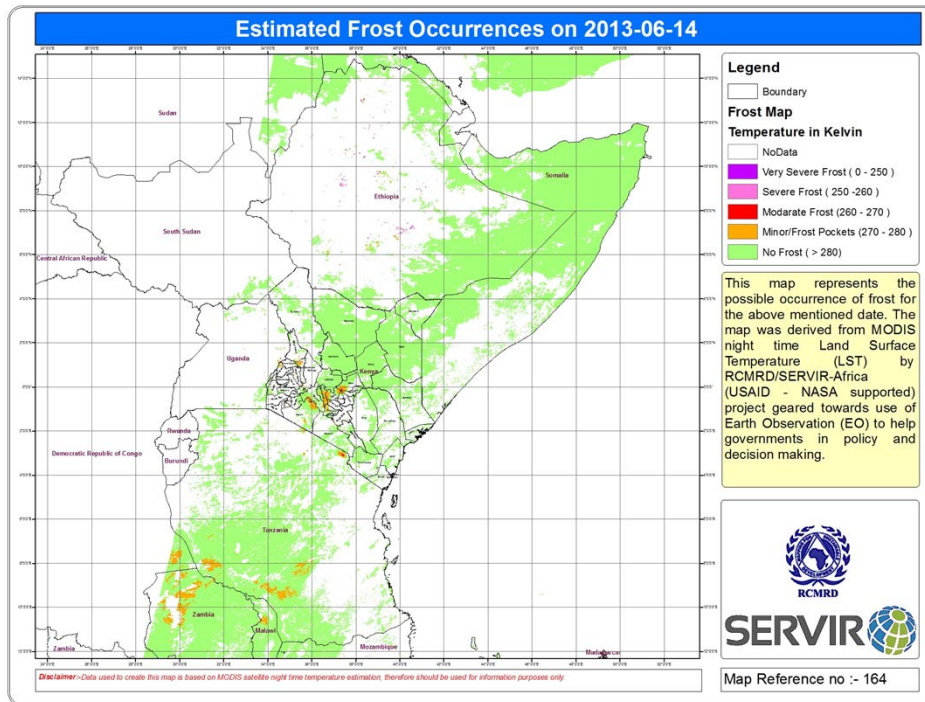
- SERVIR is keen on getting satellite data and products to end users in the agricultural community to improve decision making.

- In Kenya, as with many other countries in Africa, frost damages are a significant threat to agriculture.

- Kenya Meteorological Department requested SERVIR to help with identifying the frost damaged areas, for public dissemination and damage assessment purposes.

- Using satellite and KMD datasets, SERVIR Africa has put together a system for early detection of frost and for damaged area assessment. Next phases will include near real time temperature observations and forecasts of frost areas.

Mesoscale Atmospheric Modeling
WRF for Mesoamerica and Improvements in East Africa

- SERVIR, with the help of NASA Short-term Prediction Research and Transition Center (SPoRT), is producing real-time numerical weather forecasts for Mesoamerican region at the request from Meteorological Services in the region.

130213/0600V024 24-h Accumulated Precipitation (mm)
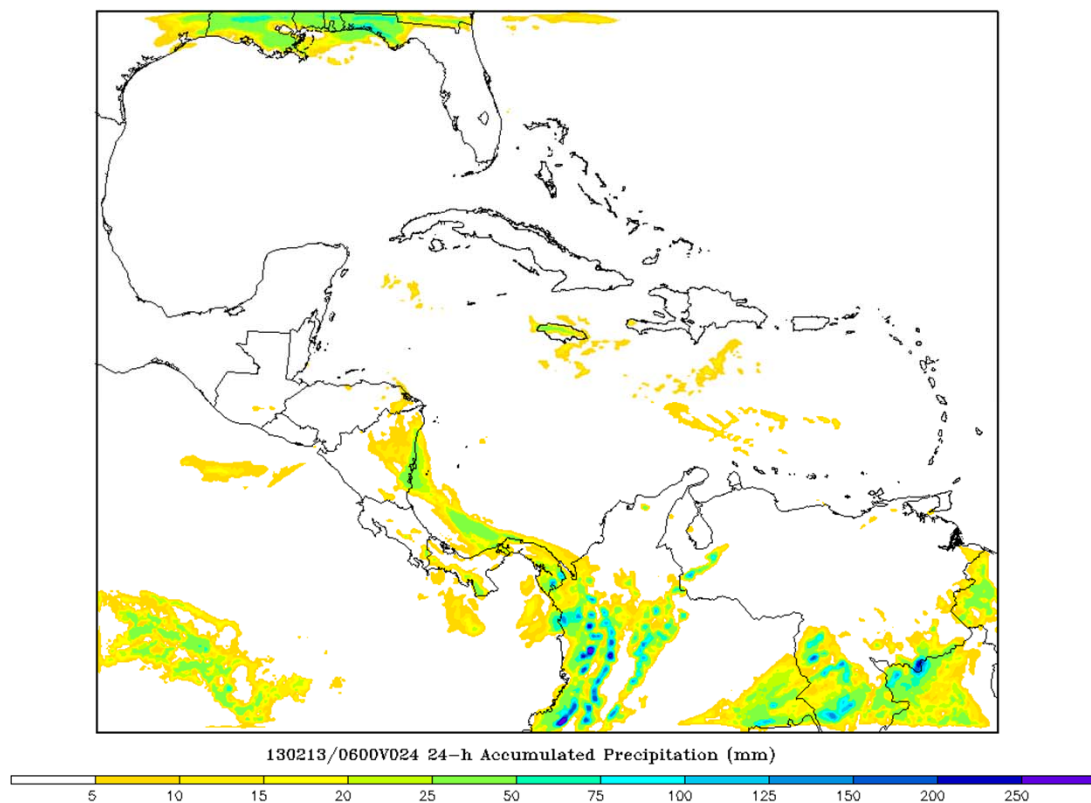
KMS Needs in East Africa

- Kenya Meteorological Service (KMS) has responsibilities analogous to US National Weather Service.

- KMS uses numerical weather forecasting model WRF, along with the observed data, to generate alerts on potential vulnerabilities in the region, such as floods and droughts, and to support the agriculture sector with accurate weather information.

- KMS alerts are well regarded and widely used in the region. However KMS does not use satellite datasets in generating their numerical weather forecasts. KMS recognize the potential of improving the forecasts using satellite data, especially the soil moisture products from SMAP.

- KMS approached SERVIR Africa to improve their WRF modeling system. Recently, we have integrated NASA LIS into their WRF forecasts. Remotely sensed soil moisture products is expected to enhance the WRF accuracy. Our preliminary assimilations have shown substantial improvement.

0-10 cm Volumetric Soil Moisture (m3/m3*100)
LIS 0-h Forecast Valid: 00Z 06 JAN 2014
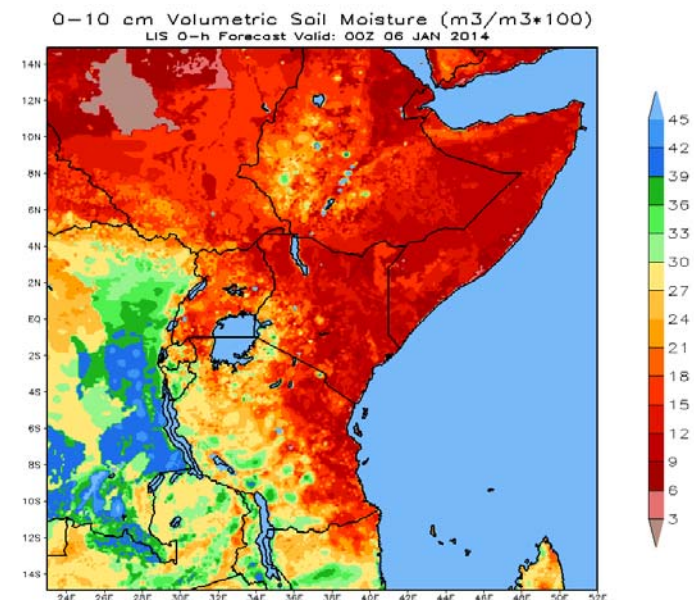
SERVIR Applied Science Team (AST)

| PI Last name	Title	Institution	Theme	Region
Laporte	Forest carbon assessment for REDD in the East Africa SERVIR region	The Woods Hole Research Center	Carbon	East Africa
Kargel	Interdisciplinary science applications to glacier and alpine hazards in relation to development and habitation in the Hindu Kush-Himalaya: SERVIR Science Team project	University of Arizona	Disasters	Hindu Kush-Himalaya
Hossain	A Satellite-based Early Warning, Mapping and Post-Disaster Visualization System for Water Resources of Low-lying Deltas of the Hindu Kush-Himalayan region	Tennessee Technological University	Water	Hindu Kush-Himalaya
Verdin	A Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa	U.S. Geological Suvey	Agriculture	East Africa
Blackman	Using Earth Observation Data to Improve REDD+ Policy in Mesoamerica and the Dominican Republic	Resources for The Future, Inc.	Carbon	Mesoamerica
Huff	Applications of Satellite Products for Air Quality Monitoring, Analysis, Forecasting, and Visualization in the SERVIR Mesoamerica and Himalaya Regions	Battelle Memorial Institute	Air Quality	Mesoamerica, Hindu Kush-Himalaya
Robertson	Leveraging CMIP5 and NASA / GMAO Coupled Modeling Capacity for SERVIR East Africa Climate Projections	NASA / MSFC	Climate Scenarios	East Africa, Hindu Kush-Himalaya, Mesoamerica
Granger	East Africa Drought and Agricultural Productivity Assessment and Prediction System	Jet Propulsion Laboratory	Disasters, Agriculture	East Africa
Valdes	SERVIR Water Africa-Arizona Team (SWAAT)	The University of Arizona	Water	East Africa
Kirschbaum	Landslide Hazard Assessment and Forecasting System using near real-time remote sensing information over SERVIR-Mesoamerica	NASA Goddard Space Flight Center	Disasters	Mesoamerica
Ceccato	Development and Implementation of Flood Risk Mapping, Water Bodies Monitoring and Climate Information for Disaster Management and Human Health (integration within SERVIR)	Columbia University	Public Health	East Africa

Improved Flood Forecasting in Bangladesh

- **Problem:** Bangladesh's severe flooding affects millions of residents every year. The Flood Forecast Warning Center (FFWC) issues flood forecasts in Bangladesh just 3 days in advance – insufficient time for families and farmers to prepare.

- **What SERVIR did:** A SERVIR AST effort led by Dr. Faisal Hossain linked satellite altimetry data (JASON 2) to flood forecasts. SERVIR-HKH has trained FFWC scientists to generate flood forecasts 8 days in advance using this near real time satellite data.
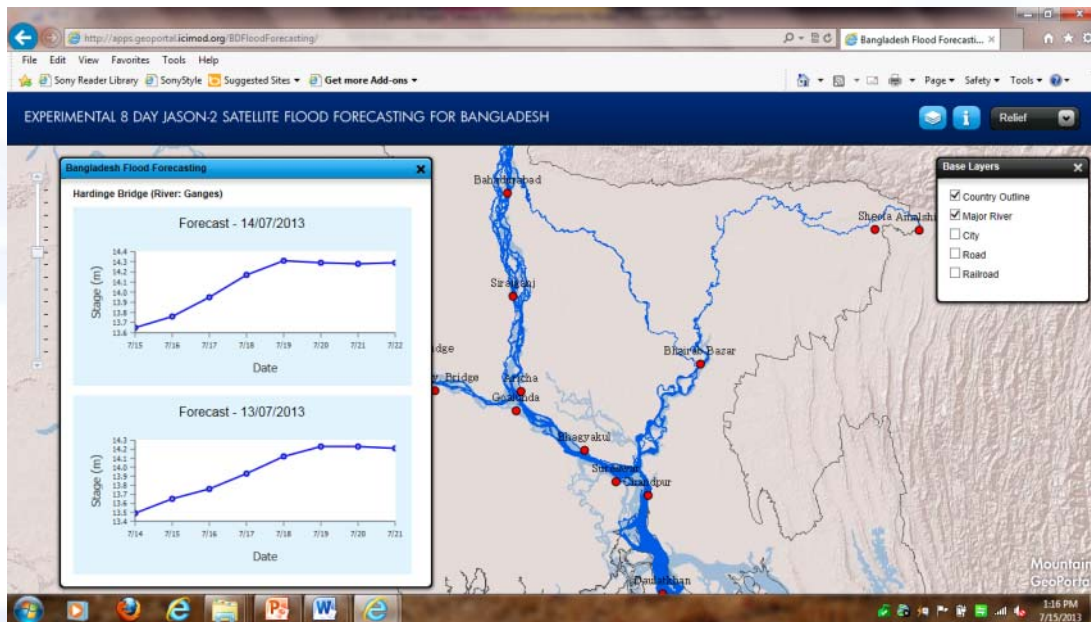
- **Results:** FFWC has begun generating experimental 8-day forecasts representing river levels for the 2014 monsoon season. The satellite-derived system is being run independently by FFWC, and is expected to be adopted as the official forecasting system for the 2015 monsoon season. The 8-day forecasts will provide 160 million impacted citizens with longer lead time for disaster preparedness.

- *Critically assess and employ CMIP5 and US NMME climate model projections of seasonal / interannual / decadal hydrometeorological climate variability / change affecting SERVIR Hub regions (Mesoamerica, E. Africa, Himalayas).*

- *Develop and refine scenarios through downscaling, and stochastic modeling to provide SERVIR Applications Science Team and Hub Scientists with information to drive decision support system models of crop production, water availability etc.*

A Big Challenge :

Identifying / Separating / Quantifying Natural Variability vs Anthropogenic Effects
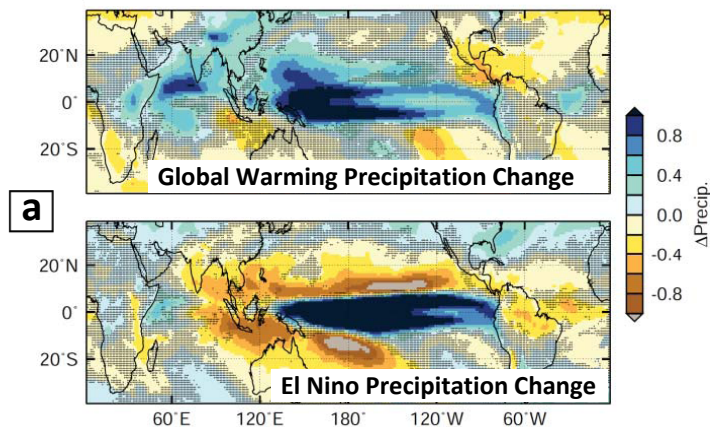
a) CMIP models show 21st Century regionally varying precipitation trends (*top panel*) due to anthropogenic forcing. Note increased rainfall over East Africa. These expected changes will mix with natural climate variability (*lower panel*).
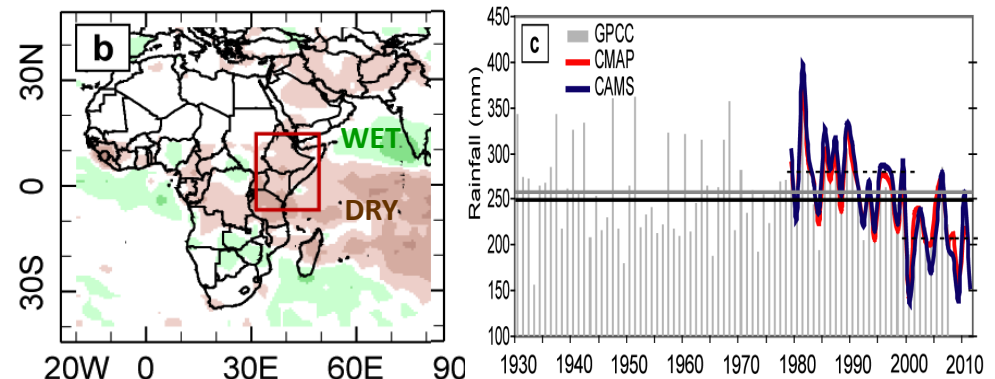
b) Satellite-observed Mar-May (1999-2010 avg) rainfall departure from 1979-2010 mean.

c) Mar-May observed and satellite-estimated rainfall averaged over East Africa (10S-12N, 30-53E). Why does this decadal trend contrast with model-projected increases?

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- SERVIR is a link between research institutions and end user decision making.

- SERVIR efforts are led by the needs of the region. Some examples include hydrological modeling, frost monitoring, fire alert system, and land cover change assessment.

- Presence of SERVIR Hub, a technical institution with regional governmental support, makes the linkage sustainable.

More information:

SERVIR Global: http://www.servirglobal.net

SERVIR Contacts:

Daniel Irwin – Project Director

Nancy Searby – NASA HQ Program Manager

Ashutosh Limaye – Project Scientist (Ashutosh.Limaye@nasa.gov)

SERVIR GLOBAL

Aquarius

OSTM/Jason 2 (NOAA)

Jason

QuikSCAT*

TRMM

EO-1

Landsat-7 (USGS)

Aqua

ACRIMSAT

Terra

SORCE

GRACE (2)

Aura

CALIPSO

CloudSat

Connecting Space
To Village